April 14, 2011

Mr. Ralph Butler, Director
Research Reactor Center
University of Missouri - Columbia
Research Park
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI – COLUMBIA RESEARCH REACTOR – NRC ROUTINE INSPECTION REPORT NO. 50-186/2011-201

Dear Mr. Butler:

On March 21–24, 2011, the U.S. Nuclear Regulatory Commission (NRC, the Commission) completed an inspection at the University of Missouri - Columbia Research Reactor (Inspection Report No. 50-186/2011-201). The enclosed report documents the inspection results, which were discussed on March 24, 2011, with you and members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, observed of activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390, "Public inspections, exemptions, and requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any questions concerning this inspection, please contact Craig Bassett at 301-466-4495 or by electronic mail at Craig.Bassett@nrc.gov.

Sincerely,

/RA/

Johnny H. Eads, Jr., Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-186
License No. R-103

Enclosure: NRC Inspection Report No. 50-186/2011-201
cc w/encl: See next page

cc:

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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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DATE	03/31/2011	04/14/2011	4/14/2011

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U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No.:	50-186
License No.:	R-103
Report No.:	50-186/2011-201
Licensee:	Curators of the University of Missouri – Columbia
Facility:	University of Missouri – Columbia Research Reactor
Location:	Research Park Columbia, Missouri
Dates:	March 21–24, 2011
Inspector:	Craig Bassett
Accompanied by:	Phillip Young
Approved by:	Johnny H. Eads, Jr., Chief Research and Test Reactors Oversight Branch Division of Policy and Rulemaking Office of Nuclear Reactor Regulation

EXECUTIVE SUMMARY

University of Missouri – Columbia
University of Missouri – Columbia Research Reactor
Report No.: 50-186/2011-201

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the University of Missouri - Columbia (the licensee's) 10 Megawatt Class I research and test reactor safety program including: 1) organizational structure and staffing; 2) review and audit and design change functions; 3) procedures, 4) radiation protection, 5) environmental monitoring; and 6) transportation of radioactive material since the last NRC inspection of these areas. The licensee's program was acceptably directed toward the protection of public health and safety, and in compliance with the U.S. Nuclear Regulatory Commission (NRC) requirements. No violations or deviations were identified.

Organization and Staffing

- The licensee's organization and staffing were in compliance with the requirements specified in Technical Specifications Section 6.1.

Review and Audit and Design Change Functions

- Review and oversight functions required by Technical Specifications Section 6.1 were acceptably completed by the Reactor Advisory Committee.

- The design change program and procedures, which outlined the review and evaluation of changes to structures, systems, and components, and procedures and other documentation at the facility, satisfied NRC requirements.

Procedures

- The procedure review, revision, control, and implementation program satisfied Technical Specifications requirements.

Radiation Protection

- Surveys were completed and documented as outlined in the Annual Report.

- Postings and notices met regulatory requirements.

- Staff personnel were wearing dosimetry as required and recorded doses were within the NRC's regulatory limits.

- Radiation survey and monitoring equipment was being maintained and calibrated as required.

- The Radiation Protection and As Low As Reasonably Achievable Programs satisfied regulatory requirements.

- Annual reviews of the Radiation Protection Program were being completed by the licensee as required by Title 10 of the *Code of Federal Regulations* Part 20.

Effluent and Environmental Monitoring

- Effluent monitoring satisfied license and regulatory requirements.
- Releases were within the specified regulatory and Technical Specifications limits.

Transportation of Radioactive Materials

- Radioactive material was being shipped in accordance with the applicable regulations.

REPORT DETAILS

Summary of Plant Status

The University of Missouri - Columbia Research Reactor (MURR) continued to be operated in support of isotope production, silicon irradiation, reactor operator training, and various types of research. During the inspection, the reactor was operated continuously following the weekly maintenance shutdown to support laboratory experiments and product irradiation.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure [IP] 69006)

To verify that the staffing and organizational structure requirements were being met as specified in Technical Specifications (TS), Section 6.1.a, Revision (Rev.) Number (No.) 13, which was implemented through Amendment No. 34 to Facility Operating License No. R-103, dated October 10, 2008, the inspectors reviewed:

- Administrative controls and management responsibilities
- Current MURR organizational structure with respect to radiation protection
- Operations and radiation protection (also referred to as health physics) staffing requirements for safe operation of the facility
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2010, through December 31, 2010, issued February 25, 2011

b. Observations and Findings

The inspectors noted that the organizational structure had changed since the last inspection in the area of radiation protection (refer to NRC Inspection Report No. 50-186/2010-201). The change had occurred in “upper” management and involved the realignment of some of the operational units under different/new Associate Directors. It was also noted that a new Associate Director position had been created. The Reactor Manager now reports to the Facility Director through the Associate Director for Reactor and Facilities Operations while the Health Physics Manager continued to report to the Facility Director through the Associate Director for Regulatory Assurance.

The Health Physics (HP) Group was staffed with a Health Physics Manager, a Radioactive Waste Coordinator, and four HP technicians. The Waste Coordinator was a health physicist. At the time of the inspection, a Project Manager position within the group was open because the individual who had held the position had accepted a job at another facility. The licensee was trying to get authorization to actively seek a qualified person to fill the position.

The organizational structure remained in accordance with the requirements of the TS and staffing appeared to be adequate for the current level of operations. Qualifications of the staff members met program requirements. Review of records indicated that management responsibilities were discharged as required by applicable procedures.

c. Conclusion

The licensee's organization and staffing with respect to radiation protection were in compliance with the requirements specified in TS Section 6.1.a.

2. Review and Audit and Design Change Functions

a. Inspection Scope (IP 69007)

In order to verify that the licensee had established and conducted reviews and audits as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20 and TS Section 6.1 and to ensure that facility changes were reviewed and approved in accordance with 10 CFR 50.59, the inspectors reviewed:

- Radiation Protection Plan Audit for 2009 and 2010
- Selected audits and reviews completed by management and HP personnel
- Selected Subcommittee meeting minutes from September 2009 to the present including the Isotope Use Subcommittee, the Reactor Safety Subcommittee, and the Reactor Procedure Review Subcommittee
- MURR Reactor Advisory Committee meeting minutes, and related documents, from October 2009 to the present
- Selected Modification Records and 50.59 Screen Forms processed during 2010
- MURR Procedure AP-RO-115, “Modification Records,” Rev. 6, issued July 1, 2010
- MURR Procedure AP-RR-003, “10 CFR 50.59 Evaluations,” Rev. 6, issued December 7, 2010
- MURR Administrative Policy, POL-3, “MURR Radiation Protection Program,” Rev. 10, issued January 7, 2011
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2010, through December 31, 2010, issued February 25, 2011

b. Observations and Findings

(1) Review and Audit Functions

The inspectors reviewed the meeting minutes of the Reactor Advisory Committee (RAC) and the meeting minutes of various subcommittees from the September/October 2009 time frame to the present. The minutes, and associated documents, indicated that the RAC met at the required frequency and that a quorum was present. The topics considered during the committee meetings and during the subcommittee meetings were appropriate and as stipulated in the TS.

The inspectors reviewed the latest audits of the licensee’s Radiation Protection (RP) program. It was noted that the Regulatory Assurance

Group (RAG) had developed an internal audit program consisting of three modules. Members of the RAG conducted audits and reviews of the RP program annually using one of the modules that had been developed. After a three year cycle, all aspects of the RP Program were fully reviewed. Following each audit, the full RAC reviewed the results. No significant issues were identified during the audits but several areas for improvement were noted. The inspectors also reviewed the Health Physics Manager's response to the audit findings to address each of the areas for improvement. The audits and the responses to the audits appeared to be acceptable.

(2) Design Change Functions

The regulatory requirements concerning change control stipulated in 10 CFR 50.59 were implemented at the facility through MURR Procedures AP-RR-003 and AP-RO-115. The procedures were developed to address activities that would result in changes to the facility Hazards Summary Report (HSR), modifications to the facility, changes to MURR procedures, new tests or experiments not described in the HSR, revisions to NRC approved analysis methodology, and/or proposed compensatory actions to address degraded or non-conforming conditions. The procedures adequately incorporated criteria provided by the regulations with additional requirements mandated by local conditions.

The inspectors reviewed selected Modification Records and 50.59 Screen Forms processed during 2010. The completed forms showed that the proposed changes and/or modifications were acceptably reviewed in accordance with the procedures. It was noted that one of the changes or modifications dealt with replacing the current NMC RAK stack monitoring system with an improved Lab Impex system. The appropriate reviews and forms had been completed as required. The inspectors noted that none of the modifications proposed in 2010 were determined to constitute a safety question or concern and none required a license or TS amendment.

c. Conclusion

Review and oversight functions required by the TS were acceptably completed by the RAC. The design change program was comprehensive and satisfied NRC requirements.

3. Procedures

a. Inspection Scope (IP 69008)

To verify compliance with TS Sections 6.1.b and 6.1.c, the inspectors reviewed selected portions of the following:

- MURR Procedure AP-HP-105, "Radiation Work Permit," Rev. 10, issued November 23, 2010

- MURR Procedure AP-HP-117, “MURR Initial Radiation Worker Training Program,” Rev. 10, issued January 11, 2011
- MURR Procedure AP-RR-015, “Work Control Program,” Rev. 14, issued December 7, 2010
- MURR Procedure AP-SH-001, “Administrative Procedure, Radioactive Materials Shipping,” Rev. 7, issued March 11, 2011
- MURR Procedure IC-HP-310, “Calibration - Eberline Model PING 1A Stack Monitor - Particulate Channel,” Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-311, “Calibration - Eberline Model PING 1A Stack Monitor - Iodine Channel,” Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-312, “Calibration - Eberline Model PING 1A Stack Monitor - Gas Channel,” Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-350, “Calibration – Lab Impex Stack Monitor – Iodine Channel,” Rev. 0, issued December 3, 2009
- MURR Procedure IC-HP-351, “Calibration – Lab Impex Stack Monitor – Gas Channel,” Rev. 0, issued December 3, 2009
- MURR Procedure IC-HP-352, “Calibration – Lab Impex Stack Monitor – Flowrate Meter,” Rev. 1, issued March 16, 2011
- MURR Procedure IC-HP-353, “Calibration – Lab Impex Monitor – DP2001,” Rev. 0, issued February 16, 2011
- MURR Procedure OP-HP-222, “Air Sampling – Containment Building Ar-41,” Rev. 5, issued March 16, 2011
- MURR Administrative Policy, POL-18, “Procedure Writer’s Guide,” Rev. 7, issued October 5, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2010, through December 31, 2010, issued February 25, 2011

b. Observations and Findings

(1) General Review

Technical Specification 6.1.c required that the RAC review procedure changes with safety significance. The Reactor Procedure Review Subcommittee was established and chartered to fulfill this requirement. The inspectors verified that the subcommittee was meeting as required to review current procedure revisions and changes.

The inspectors noted that nearly all of the procedures at MURR had been through a full review and revision process. The procedures reviewed by the inspectors had been reviewed during the annual review as required.

The inspectors observed various activities during the inspection. The majority of the activities were conducted in accordance with the appropriate procedures and no problems were noted. Procedure compliance was acceptable.

(2) Review of Environmental Procedures

During a detailed review of the facility environmental procedures it was noted that procedures HP-310, -311, and -312 contained rather vague wording regarding PING Stack Monitor calibrations and when resultant changes might be needed in the alarm setpoints The inspectors also noted that there were no data sheets included with procedures HP-350 and -351 and the references to the data sheets were incorrect.

The licensee was informed that the issue of taking actions to address deficiencies noted in HP procedures (i.e., 1) revise the wording concerning calculations for PING alarm setpoint changes in HP-310, -311 and -312, and 2) correct reference to data record number in HP-350 and -351) would be considered an Inspector Follow-up Item (IFI) and will be reviewed during subsequent inspections (IFI-50-186/2011-201-01).

c. Conclusion

The procedure review, revision, control, and implementation program satisfied TS requirements.

4. Radiation Protection

a. Inspection Scope (IP 69012)

The inspectors reviewed the following to verify compliance with 10 CFR Part 20 and the applicable licensee TS requirements and procedures:

- Radiation protection (Rad Worker) training records
- MURR dosimetry records for 2009, 2010, and 2011 to date
- Dose Report Review Forms for October 2010 – February 2011
- Selected radiation and contamination survey records for the past year
- Radiological signs and posting in various facility laboratories and in the Beam Port Floor area
- Calibration and periodic check records for selected radiation survey and monitoring instruments for the past two years
- MURR Procedure AP-HP-105, “Radiation Work Permit,” Rev. 10, issued November 23, 2010, and the associated form, Form FM-17, “Radiation Work Permit”
- MURR Procedure AP-HP-117, “MURR Initial Radiation Worker Training Program,” Rev. 10, issued January 11, 2011, and the associated forms, Form FM-26, “MURR Training Questionnaire,” and Form FM-29, “Initial Training Packet”
- MURR Procedure AP-HP-119, “High Radiation Area Access,” Rev. 2, issued February 13, 2009
- MURR Procedure AP-HP-123, “Visitor Dosimetry – Reception Desk,” Rev. 7 issued February 4, 2010
- MURR Procedure AP-HP-125, “Review of Unplanned Radiation Exposure,” Rev. 3, issued November 23, 2010

- MURR Procedure AP-HP-130, “Reactor License Projects Annual Review,” Rev.4, issued September 30, 2010
- MURR Procedure IC-HP-300, “Calibration - Radiation Survey Instruments,” Rev. 5, issued March 18, 2009, and the associated form, Form FM-62, “Radiation Instrument Certificate of Calibration”
- MURR Procedure IC-HP-333, “Calibration - Eberline BC-4 Beta Swipe Counter,” Rev. 5, issued February 13, 2009
- MURR Procedure IC-HP-335, “Calibration - Portal Monitor Gamma-60 - S/N 900644,” Rev. 7, issued April 29, 2009
- MURR Procedure OP-HP-220, “Tritium Bioassay,” Rev. 6, issued November 23, 2010
- MURR Procedure OP-HP-306, “Daily Facility Checks,” Rev. 3, issued September 30, 2010
- MURR Procedure RP-HP-100, “Contamination Monitoring - Performing a Swipe,” Rev. 5, issued January 18, 2008
- MURR Procedure RP-HP-120, “Personnel Radioactive Contamination,” Rev. 6, issued April 29, 2009, and the associated forms, Form FM-54, “Report of Personnel Contamination,” and Form FM-76, “Personnel Contamination Log”
- MURR Procedure SV-HP-119, “Property Release,” Rev. 4, issued June 9, 2010
- MURR Administrative Policy, POL-3, “MURR Radiation Protection Program,” Rev. 10, issued January 7, 2011
- MURR Administrative Policy, POL-17, “MURR Training Booklet (Security, Emergency, and Health Physics),” Rev. 1, issued July 14, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2010, through December 31, 2010, issued February 25, 2011

The inspectors also toured the MURR facility and observed the use of dosimetry and survey meters. In addition, the inspectors conducted a radiation survey using a licensee meter and interviewed licensee personnel.

b. Observations and Findings

(1) Surveys

Daily, monthly, and other periodic contamination and radiation surveys, outlined in the licensee’s Reactor Operations Annual Report for 2009, were completed by HP staff members. Any contamination detected in concentrations above established action levels was noted and the area or item was decontaminated. Results of the surveys were typically documented on survey maps and posted at the entrances to the various areas surveyed so that facility workers and visitors would be aware of the radiological conditions that existed therein.

(2) Postings and Notices

Copies of current notices to workers were posted in appropriate areas in the facility. The copies of NRC Form-3 noted at the facility were the latest issue, as required by 10 CFR Part 19, and were posted in various areas throughout the facility such as on the main bulletin board, in main hallways, and at the entrance to the Beam Port Floor area. The inspectors determined that radiological signs, as well as the survey maps noted above, were typically posted at the entrances to controlled areas. Other postings also showed the industrial hygiene hazards that were present in the areas as well.

(3) Dosimetry Use and Results

Through direct observation the inspectors determined that dosimetry was acceptably used by facility and contractor personnel. The inspectors determined that, last year, the licensee used optically stimulated luminescent (OSL) dosimetry for whole body monitoring and thermoluminescent dosimeters (TLDs) in the form of finger rings and wrist badges for extremity monitoring. Because a new dosimetry vendor had been selected, the licensee was now using TLDs for all monitoring applications. The dosimetry was formerly supplied and processed by Landauer but was now supplied by Mirion Technologies (GDS), Inc. Both were/are National Voluntary Laboratory Accreditation Program accredited vendors.

An examination of the OSL and TLD results indicating radiological exposures at the facility for the past two years showed that the highest occupational doses, as well as doses to the public, were within 10 CFR Part 20 limits. The records showed that approximately half of the facility personnel received occupational exposures of zero to only a few millirem above background. The highest annual whole body exposure received by a single individual for 2009 was 887 millirem (mr) deep dose equivalent (DDE). The highest annual extremity exposure for 2009 was 6,080 mr shallow dose equivalent (SDE) and the highest skin dose that year was 900 mr SDE. The highest annual whole body exposure received by a single individual for 2010 was 1372 mr DDE. The highest annual extremity exposure for 2010 was 4300 mr SDE and the highest skin dose was 1503 mr SDE. In 2009, the highest whole body exposure was received by a person in the shipping group. The same was true in 2010. The highest extremity exposure in 2009 was received by a person in the Facility Operations group while the highest extremity exposure in 2009 was received by a person in the shipping group. Review of exposure records also showed that the Reactor Operations Group received approximately 53.5% of the facility's annual dose for 2009 and approximately 50.5% of the facility's annual dose for 2010.

The facility also collected and analyzed urine samples for Tritium (H-3) bioassay purposes. The highest attributable dose in 2009 from H-3 was

1.57 mr committed effective dose equivalent (CEDE). The highest H-3 attributable dose in 2010 was approximately 1.86 mr CEDE.

(4) Radiation Monitoring Equipment

Examination of selected radiation monitoring equipment indicated that the instruments had the acceptable up-to-date calibration sticker attached. The instrument calibration records indicated that the calibration of swipe counters and portal monitors was typically completed by licensee staff personnel. Other instruments, such as portable survey meters, friskers, and neutron detectors were shipped to vendors for calibration. Calibration frequency met procedural requirements and records were maintained as required. The inspectors noted that Area Radiation Monitors (ARMs), as well as air monitors and stack monitors, were also being calibrated as required. These monitors were typically calibrated by licensee staff personnel.

(5) Radiation Protection Program

As noted in past reports, the licensee's Radiation Protection and As Low As Reasonably Achievable (ALARA) programs continued to be established and described in the MURR Administrative Policy, POL-3, "MURR Radiation Protection Program," and implemented through the various HP procedures that had been reviewed and approved. The programs contained instructions concerning organization, training, monitoring, personnel responsibilities, and audits. The programs, as outlined and established, appeared to be acceptable. The inspectors verified that annual reviews of the Radiation Protection Program were being completed by the licensee as required by 10 CFR Part 20. The ALARA program provided instructions and guidance for keeping doses as low as reasonably achievable and was consistent with the guidance in 10 CFR Part 20.

(6) MURR ALARA Program

In 2000, the licensee's total cumulative facility dose was 46.7 rem. The Manager of Health Physics and the HP staff, along with other MURR managers and group leaders, recognized that improvements could be made in this area. Consequently, each group established an ALARA goal for the next year and the facility dose was then tracked by group, as well as for each individual. With emphasis placed on achieving the various groups' ALARA goals, the facility dose in 2001 was 42.9 rem. Due to the establishment of aggressive ALARA goals, continued efforts on dose reduction, worker awareness, and engineered improvements, the facility dose was 34 rem in 2002, 26.9 rem in 2003, and 27 rem in 2004. In 2005, the facility dose was 30.7 rem. During that year the licensee began extensive planning and preparation for two major projects that were planned for 2006.

In 2006, the licensee successfully completed two major tasks including the replacement of the beryllium reflector and the removal and replacement of two primary reactor heat exchangers. Even though the facility dose increased, the total cumulative dose was held to 33.8 rem, less than the annual dose received in 2000, 2001, or 2002. In 2007, the cumulative facility dose was 33.6 rem. During 2008 and 2009, MURR management and staff continued their efforts to maintain personal doses ALARA. The total cumulative facility dose for 2008 increased slightly and was 33.7 rem. It was noted that the total cumulative facility dose for 2009 had decreased substantially and was 27.9 rem. In 2010, the cumulative facility dose had increased slightly to 28.7 rem. This was due in part to an increase in the amount of product irradiation work performed during the year.

(7) Corrective Action Program Item – Loss of Control Over Access to the Hot Cell Posted as a Very High Radiation Area

Regulation 10 CFR 20.1601(a)(3) requires that the licensee shall ensure that each entrance or access point to a high radiation area has --- entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry.

Regulation 10 CFR 20.1602 requires that, in addition to the requirements in 10 CFR 20.1601, the licensee shall institute additional measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 500 rads (5 grays) or more in 1 hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

The licensee routinely irradiates various types of samples in the reactor using experimental facilities including reflector region irradiation positions and the center test hole or flux trap. After a designated length of irradiation, these samples are moved from the reactor in a transfer cask to the Hot Cell located in the basement of the building. The Hot Cell is posted as a Very High Radiation Area and the door to the Hot Cell is also posted with a sign stating that Health Physics coverage is needed when using the Hot Cell. Access to the Hot Cell is controlled by the Health Physics group through the use of a key. The key is inserted into a switch which is used to energize the motor and chain system that opens the heavy, shielded, and reinforced concrete door. Inside the Hot Cell, samples are removed from the transfer cask and processed further or moved into a shielded container which is then removed from the Hot Cell and loaded into a shipping cask for shipment to a consumer. It should be noted that access to the Reactor Building is controlled through a key card system and only authorized and trained personnel are given key cards and allowed inside the building. Access to the basement where the Hot Cell is located is also controlled by the key card system and a person needs further training to enter that area.

The inspectors reviewed Corrective Action Program (CAP) Item Number 11-0009, "Loss of Access Control to Very High Radiation Area." The CAP Item indicated that, on the night of March 16, 2011, while conducting routine rounds of the facility, a reactor operator found that the key used to open the shielded door to the Hot Cell had been left in the switch. As noted above, the Hot Cell can only be accessed by turning the key and activating a motor and chain system which opens the heavy shielded door. The key is normally maintained locked up in the HP office or under the control of Health Physics Technicians when it is not being used to open the door for ongoing work activities. Leaving the key in the switch on the Hot Cell door could potentially allow an individual to gain unauthorized or inadvertent access to an area in which radiation levels could be encountered at 500 rads (5 grays) or more in 1 hour.

The reactor operator removed the key and temporarily placed it in the Control Room lock box. The issue was then written up in the CAP system. Through an initial review of the issue, the licensee had determined that the issue was not a reportable event under 10 CFR 20.2201, 2202, or 2203. However, since this event had only recently occurred, the licensee had not been able to formally and fully review the event and take corrective action.

Following review by the inspectors, the licensee was informed that, pending the licensee's formal review of the event and completion of corrective actions, this issue would be identified as an Unresolved Item[1] (URI) by the NRC and will be reviewed during a future inspection (URI 50-186/2011-201-02).

(8) Facility Tours

On various occasions during the inspection, the inspectors toured the Hot Cell area, Beam Port Floor area, and selected support laboratories with licensee representatives. During one tour of the Beam Port Floor, the inspectors conducted a radiation survey along with a licensee representative. The readings noted by the inspectors were generally similar to those found by the licensee. No unmarked radioactive material was noted and no other anomalies were noted. The inspectors noted that facility radioactive material storage areas were properly posted. Radiation and High Radiation Areas were posted as required and properly controlled.

c. Conclusion

The inspectors determined that the Radiation Protection and ALARA Programs, as implemented by the licensee, satisfied regulatory requirements because: 1) surveys were completed and documented acceptably to permit evaluation of

[1]An Unresolved Item is a matter about which more information is required to determine whether the issue in question is an acceptable item, a deviation, a nonconformance, or a violation.

the radiation hazards present; 2) postings met regulatory requirements; 3) personnel dosimetry was being worn as required and recorded doses were within the NRC's regulatory limits; 4) radiation survey and monitoring equipment was being maintained and calibrated as required; and, 5) the Radiation Protection Program was acceptable and was being reviewed annually as required.

5. Effluent and Environmental Monitoring

a. Inspection Scope (IP 69004)

The inspectors reviewed the following to verify compliance with the requirements of 10 CFR Part 20 and TS Section 3.7:

- Environmental monitoring program outlined through various procedures
- Monthly ALARA Environmental Review Reports for 2010 and to date in 2011
- Liquid Batch Release Review Forms for 2010 associated with the Monthly ALARA Environmental Review Reports
- MURR Procedure IC-HP-310, "Calibration - Eberline Model PING 1A Stack Monitor - Particulate Channel," Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-311, "Calibration - Eberline Model PING 1A Stack Monitor - Iodine Channel," Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-312, "Calibration - Eberline Model PING 1A Stack Monitor - Gas Channel," Rev. 5, issued January 18, 2008
- MURR Procedure IC-HP-318, "NMC Model RAK Stack Monitor Offsets/Multipliers/High Voltages Determination," Rev. 5, issued February 15, 2008
- MURR Procedure IC-HP-319, "Calibration NMC Model RAK Stack Monitor – Particulate Channel," Rev. 4, issued April 4, 2007
- MURR Procedure IC-HP-320, "Calibration NMC Model RAK Stack Monitor – Iodine Channel," Rev. 4, issued April 4, 2007
- MURR Procedure IC-HP-321, "Calibration NMC Model RAK Stack Monitor – Gas Channel," Rev. 4, issued April 18, 2007
- MURR Procedure IC-HP-350, "Calibration – Lab Impex Stack Monitor – Iodine Channel," Rev. 0, issued December 3, 2009
- MURR Procedure IC-HP-351, "Calibration – Lab Impex Stack Monitor – Gas Channel," Rev. 0, issued December 3, 2009
- MURR Procedure SV-HP-115, "Building Exhaust Stack Effluent – Tritium Monitoring," Rev. 4, issued October 14, 2009
- MURR Procedure SV-HP-121, "Building Exhaust Stack Effluent – Ar-41 Monitoring," Rev. 4, issued APRIL 21, 2010
- MURR Procedure OP-HP-200, "Air Sampling - Containment Building Tritium," Rev. 4, issued March 16, 2011
- MURR Procedure OP-HP-221, "Environmental Sample - Analysis," Rev. 5, issued June 6, 2007
- MURR Procedure OP-HP-222, "Air Sampling - Containment Building Ar-41," Rev. 5, issued March 16, 2011
- MURR Procedure OP-HP-353, "Waste Tank Sample - Analysis," Rev.65, issued March 16, 2011

- MURR Procedure SV-HP-110, "Environmental Sampling," Rev. 4, issued February 15, 2008
- MURR Procedure WM-SH-105, "Radioactive Waste Processing," Rev. 4, issued August 7, 2008
- MURR Reactor Operations Annual Report for the period from January 1, 2009, through December 31, 2009, issued February 24, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2010, through December 31, 2010, issued February 25, 2011

b. Observations and Findings

(1) Gaseous and Liquid Releases

The inspectors determined that gaseous releases continued to be monitored as required, were acceptably analyzed, and were documented in the annual operating reports. Airborne concentrations of gaseous releases were noted to be within the concentrations stipulated in 10 CFR Part 20, Appendix B, Table 2 and TS limits. The dose rate to the public, as a result of the gaseous releases, was below the dose constraint specified in 10 CFR 20.1101(d) of 10 mrem per year. COMPLY code results indicated an annual dose to the public of 4.0 mr for 2009 and data for 2010 indicated an annual dose to the public of 3.4 mr.

It was noted that the licensee had determined that the receptor exposed to the highest dose as a result of air effluent from the reactor was located in a building 150 meters to the north north east of MURR. The building was on land owned by the university and was considered to be on-site. The building was occupied eight hours per day, five days per week (8 hrs/day, 5 days/week) which resulted in an occupancy factor of 0.24. Thus, by applying this occupancy factor (0.24) for each year (calculated dose multiplied by the occupancy factor), the resulting annual dose to the public for 2009 was 0.96 mr. Using this same methodology, the annual dose to the public for 2010 was calculated to be 0.82 mr.

The liquid releases from the facility to the sanitary sewer also continued to be monitored as required, were acceptably analyzed, and were documented in the annual reports. The inspectors noted that the results indicated that the releases were within the limits specified in 10 CFR Part 20, Appendix B, Table 3.

(2) Environmental Soil, Water, and Vegetation Samples

The inspectors reviewed the environmental soil, water, and vegetation samples that were collected, prepared, and analyzed during 2010. These samples had all been collected and analyzed as required and within the time frame established by procedure. No problems were noted.

(3) Environmental Monitoring using TLDs

On-site and off-site gamma radiation monitoring was completed using the reactor facility stack effluent monitor and various environmental TLDs in accordance with the applicable procedures. Review of the data indicated that there were no measurable doses above any regulatory limits.

In 2008, the highest unrestricted area dose was measured in an unoccupied area from the MURR stack and was 71.7 mr. The highest unrestricted area dose in 2010 was measured in an unoccupied area 65 meters south from the MURR stack and was 75.2 mr for all of 2010

c. Conclusion

Effluent monitoring satisfied license and regulatory requirements and releases were within the specified regulatory and TS limits.

6. Transportation

a. Inspection Scope (IP 86740)

To verify compliance with regulatory and procedural requirements for transferring or shipping licensed radioactive material, the inspectors reviewed the following:

- Selected records of various types of radioactive material shipments
- Selected training records for staff personnel authorized to ship hazardous material in accordance with the regulations specified by the Department of Transportation and the International Air Transport Association
- MURR Procedure AP-SH-001, “Administrative Procedure, Radioactive Materials Shipping,” Rev. 7, issued March 11, 2011
- MURR Procedure BPB-SH-002, “20WC-1 Packaging and Shipment of Type B Non-Waste Radioactive Material,” Rev. 9, issued February 3, 2010
- MURR Procedure BPB-SH-005, “DOT 6M Packaging and Shipment of Type B Non-Waste Radioactive Material,” Rev. 8, issued September 30, 2010
- MURR Procedure BP-SH-007, “F-327 Packaging and Shipment of Type A Non-Waste Radioactive Material,” Rev. 7, issued September 9, 2010
- MURR Procedure BP-SH-010, “Packaging and Shipment of Non-Waste Radioactive Materials in Excepted Packages,” Rev. 3, issued February 3, 2010
- MURR Procedure BP-SH-011, “Shipment of Non-Waste DOT 7A Type A (Gemstone) Radioactive Material Package,” Rev. 4, issued February 3, 2010
- MURR Procedure BP-SH-013, “Packaging and Shipment of Radioactive Material Using MURR Reusable Type A Package,” Rev. 4, issued November 16, 2010
- MURR Procedure BP-SH-014, “Packaging and Shipment of Radioactive Material Using an Overpack,” Rev. 3, issued November 16, 2010

- MURR Procedure BP-SH-052, “Radioactive Material Shipment Package Documentation and Labeling,” Rev. 6, issued July 26, 2010
- MURR Procedure BP-SH-099, “Packaging of Radioactive Material Using MURR Model 1500,” Rev. 2, issued February 3, 2010
- MURR Procedure FB-SH-001, “Unirradiated Fuel Shipment Using the 110-Gallon USA DOT 6M Type B Package,” Rev. 0, issued July 7, 2007
- MURR Procedure FB-SH-005, “Type B Shipment of Spend Fuel Using BMI-1 Shipping Container,” Rev. 1, issued August 16, 2006
- MURR Procedure WM-SH-100, “Radioactive Waste - Preparation and Storage,” Rev. 5, issued June 5, 2009
- MURR Procedure WM-SH-300, “MURR Exclusive Use Shipment of LSA or SCO Radioactive Waste,” Rev. 7, issued September 24, 2009

b. Observations and Findings

During the inspection, the inspectors closely observed the preparations for a shipment of barium carbonate from the facility. After being irradiated in the reactor, the barium carbonate, which was contained in three small aluminum canisters, was moved to the Hot Cell in a transfer cask. The canisters were removed from the transfer cask and placed in a shielded container. This container was subsequently removed from the Hot Cell and placed in a Type B shipping package. The package was then moved to the shipment staging area and the container was surveyed to obtain shipping data. Shipping personnel reviewed the irradiation data and isotope quantities and verified consignee information (i.e., possession of a license to receive radioactive material, address, contacts, etc.). Shipping papers were prepared and reviewed and labels were applied to the Type B package. The inspectors verified that the shipping papers contained the appropriate information and that the appropriate markings were placed on the outside of the package. Proper techniques were followed in conducting surveys of the package and the quality assurance checks of the shipment were completed as required. Staff members conducting these shipments were knowledgeable of their duties and conducted a thorough review of all documentation.

During the aforementioned observations, the inspectors also verified that the licensee maintained on file copies of consignees’ licenses to possess radioactive material as required. As noted above, the license of each specific consignee was verified to be current prior to initiating a shipment.

The training of the staff members responsible for shipping the material was also reviewed. The inspectors verified that the shippers had received training covering the various requirements of the Department of Transportation (DOT) and the International Air Transport Association and that the training was current.

Through records review and discussions with licensee personnel, the inspectors determined that the licensee had shipped spent fuel, radioactive waste, and other types of radioactive material since the previous inspection in this area. The records indicated that the radioisotope types and quantities were calculated and

dose rates measured as required. The radioactive material shipment records reviewed by the inspectors had been completed in accordance with DOT and NRC regulations.

c. Conclusion

Radioactive material was being shipped in accordance with the applicable regulations.

7. Exit Interview

The inspection scope and results were summarized on March 24, 2011, with members of licensee management and staff. The inspectors described the areas inspected and discussed in detail the inspection findings. The licensee did not identify any of the material provided to or reviewed by the inspectors during the inspection as proprietary. No dissenting comments were received from the licensee.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

K. Brooks	Associate Director, Business Development and Central Services
R. Dobey	Health Physics Manager
J. Ernst	Associate Director, Regulatory Assurance Group
L. Foyto	Associate Director, Reactor and Facilities Operations
J. Fruits	Reactor Manager
A. Gaddy	Compliance Specialist
N. Hogue	Health Physics Technician
B. Jacobi	Assistant Reactor Manager, Operations
L. Juengermann	Shipping Manager
M. Kraus	Safety Associate and CAP Coordinator
K. Kutikkad	Assistant Reactor Manager, Physics; SNM Coordinator; and Security Director
R. Maxey	Health Physics Technician
C. McKibben	Senior Advisor
J. Mitchell	Health Physics Technician
D. Nickolaus	Health Physics Technician
S. Oberhaus	Health Physics Technician Specialist
D. Rathke	Access Control Coordinator
M. Sanford	Associate Director, Products and Services

INSPECTION PROCEDURES USED

IP 69004:	Class 1 Research and Test Reactor Effluent and Environmental Monitoring
IP 69006:	Class 1 Research and Test Reactor Organization, Operations, and Maintenance Activities
IP 69007:	Class 1 Research and Test Reactor Review and Audit and Design Change Functions
IP 69012:	Class 1 Research and Test Reactor Radiation Protection
IP 86740:	Inspection of Transportation Activities

OPENED, CLOSED, AND DISCUSSED

Opened

50-186/2011-201-01	IFI	Follow-up on the licensee's actions to update HP procedures dealing with: 1) calculations for PING alarm setpoint changes in HP-310, -311 and -312, and 2) correct reference to data record number in HP-350 and -351.
50-186/2011-201-02	URI	Review the licensee's actions to correct the problem noted concerning failure to control access to the Hot Cell area which was posted as a Very High Radiation Area.

Closed

None

LIST OF ACRONYMS USED

ARM	Area Radiation Monitor
ALARA	As low as reasonably achievable
CAP	Corrective Action Program
CEDE	Committed effective dose equivalent
10 CFR	Title 10 of the *Code of Federal Regulations*
DDE	Deep dose equivalent
DOT	Department of Transportation
H-3	Tritium
HP	Health physics
HSR	Hazards Summary Report
IATA	International Air Transport Association
IP	Inspection Procedure
Mrem	Millirem
MURR	University of Missouri - Columbia Research Reactor
No.	Number
NRC	U. S. Nuclear Regulatory Commission
OSL	Optically stimulated luminescent (dosimeter)
RAC	Reactor Advisory Committee
Rev.	Revision
RP	Radiation Protection
RWP	Radiation Work Permit
SDE	Shallow dose equivalent
TLD	Thermoluminescent dosimeter
TS	Technical Specification
URI	Unresolved Item